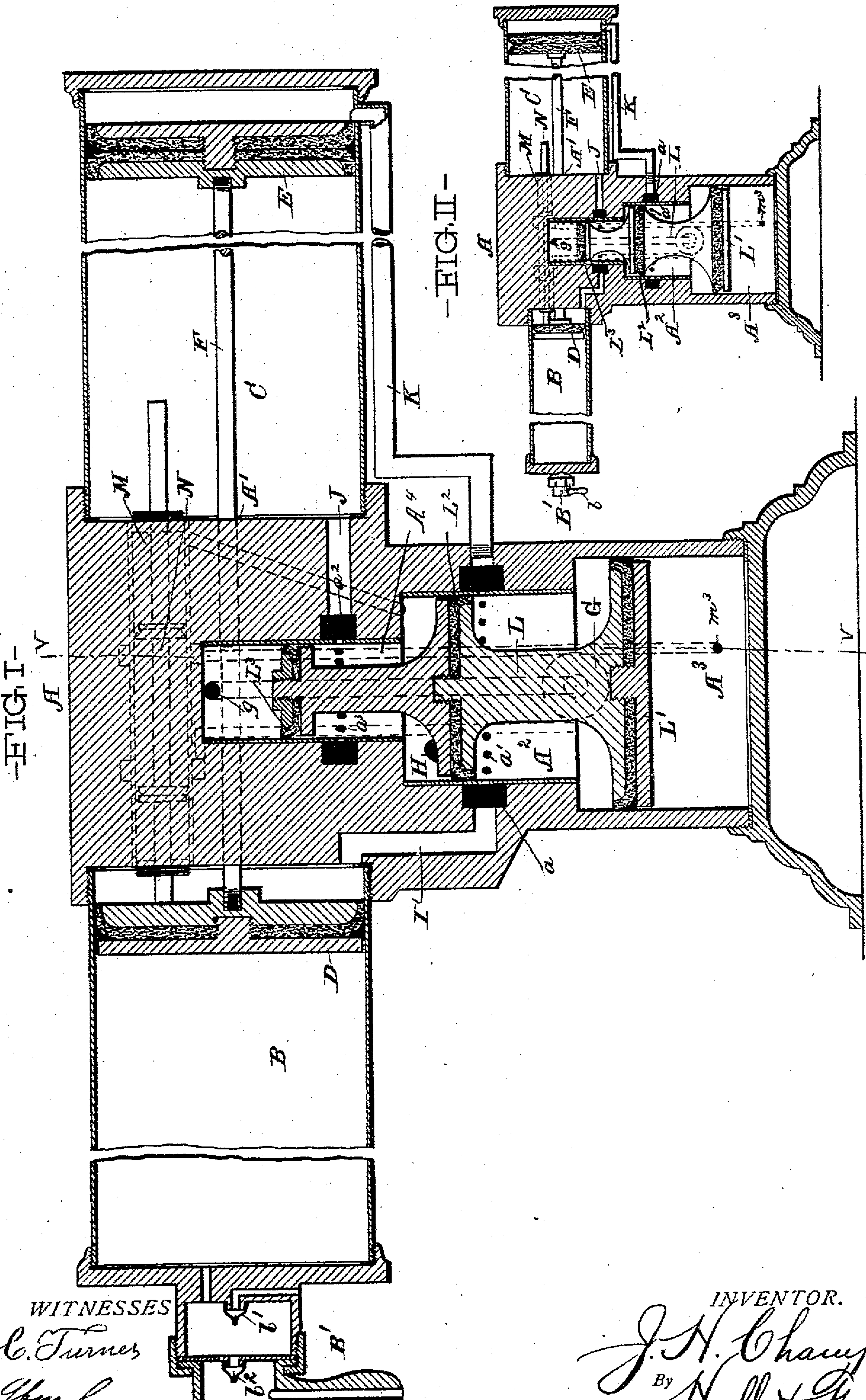
(No Model.)

4 Sheets—Sheet 1.

J. H. CHAMP.

HYDRAULIC AIR COMPRESSOR.

No. 515,516. Patented Feb. 27, 1894.



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(No Model.) 4 Sheets—Sheet 2.

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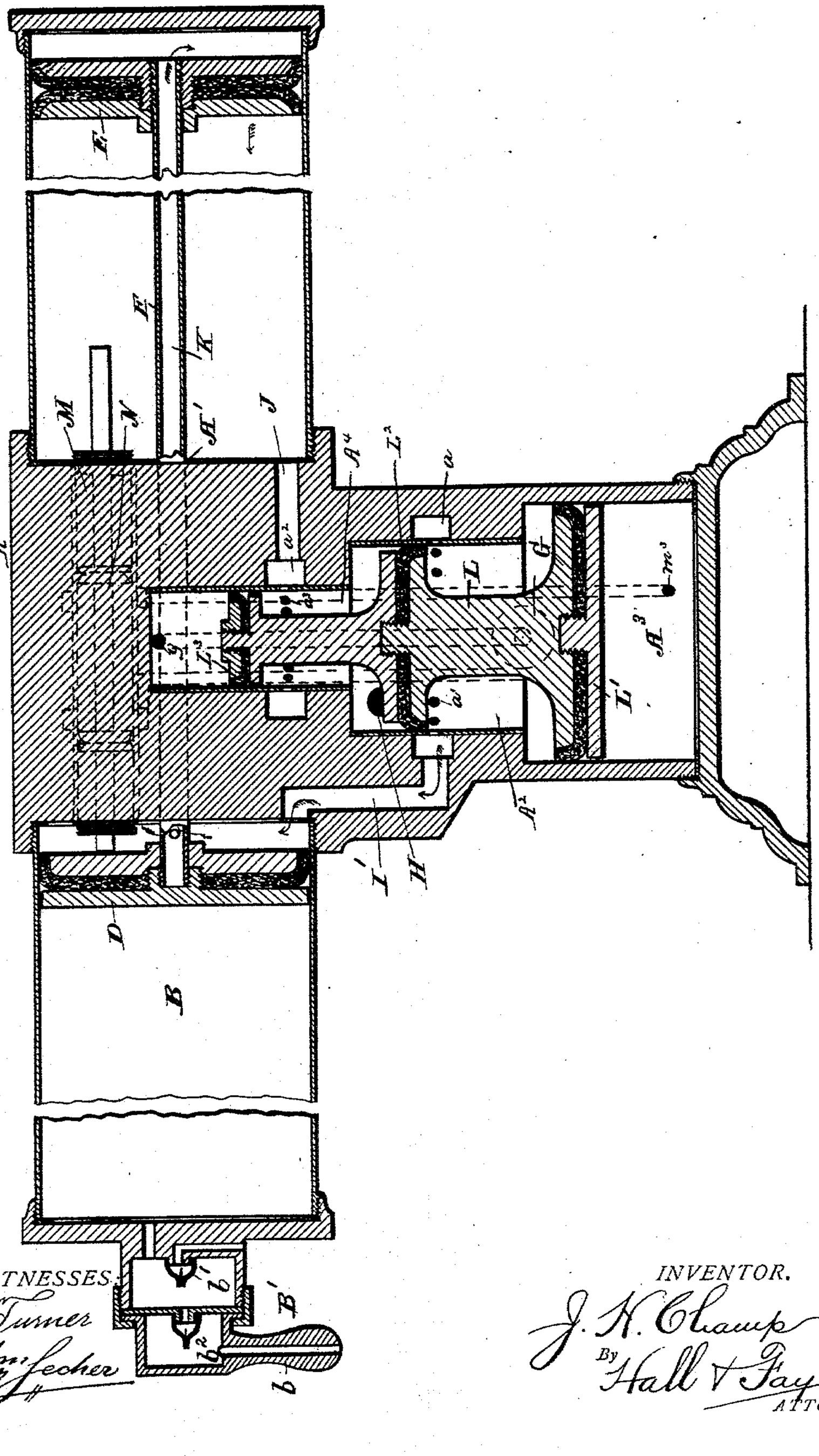
FIG. III.



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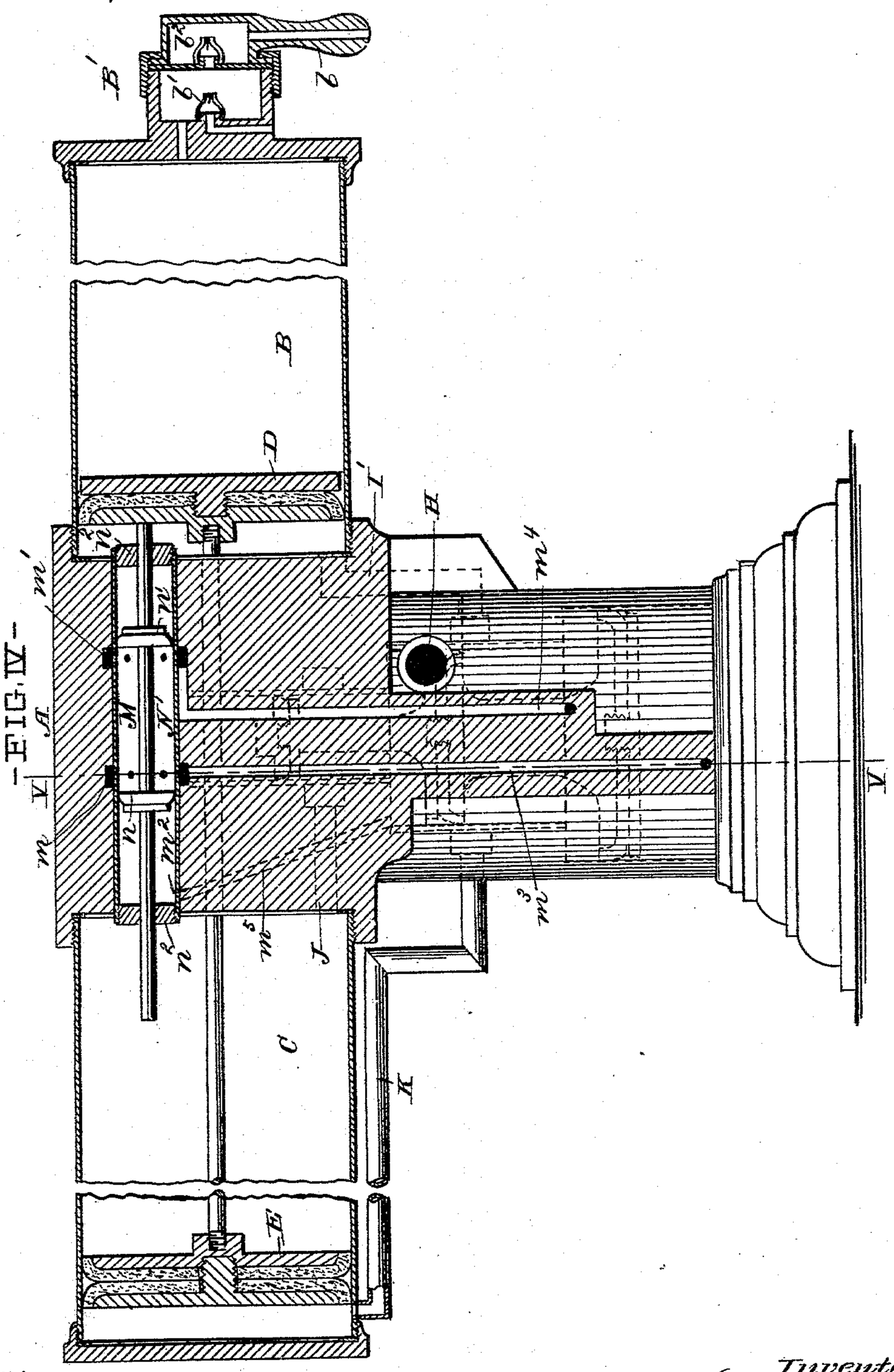

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(No Model.) 4 Sheets—Sheet 4.

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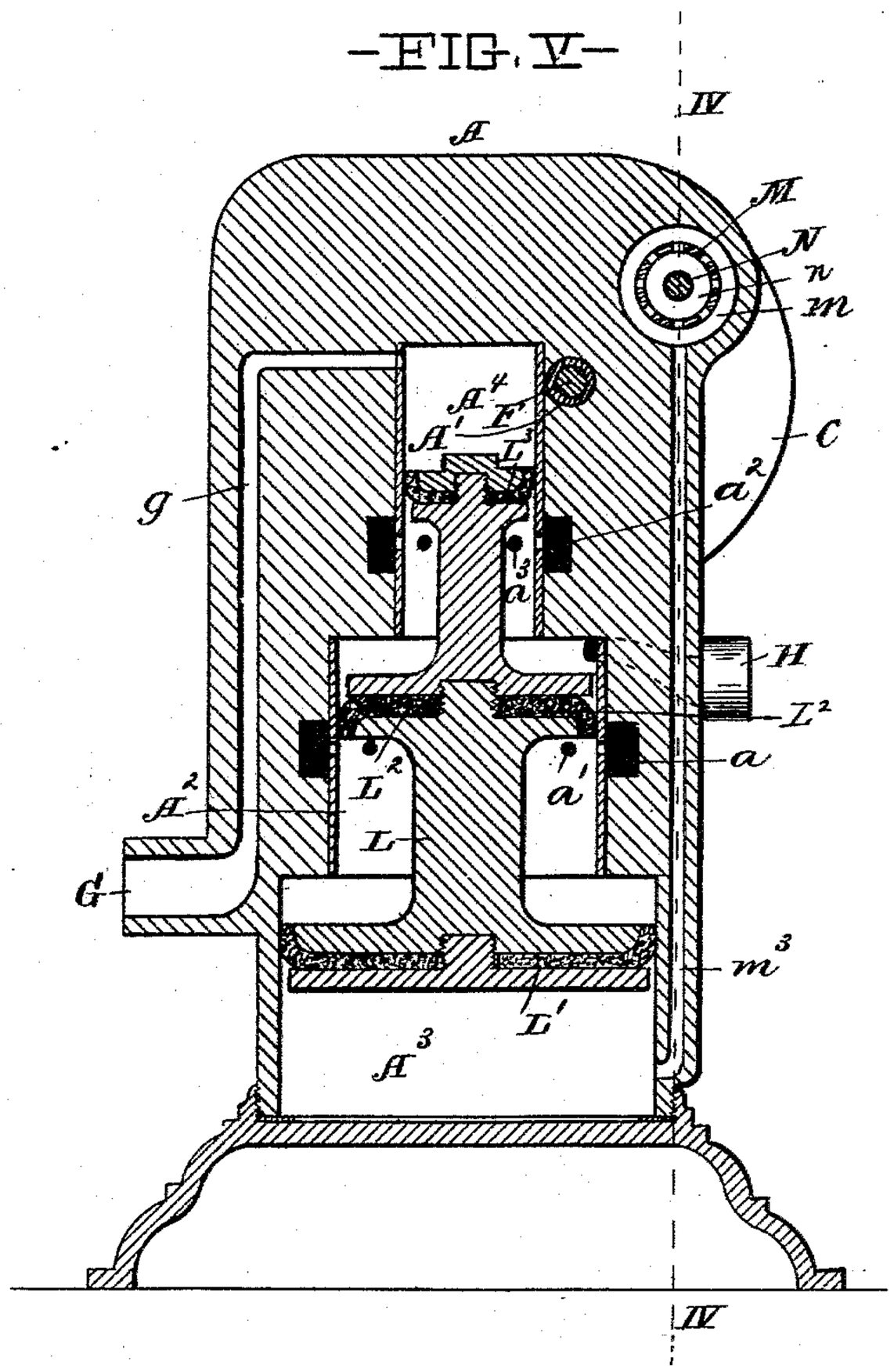
HYDRAULIC AIR COMPRESSOR.

No. 515,516. Patented Feb. 27, 1894.

FIG. V.



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UNITED STATES PATENT OFFICE.

JOSEPH H. CHAMP, OF CLEVELAND, OHIO, ASSIGNOR TO THE BISHOP & BABCOCK COMPANY, OF SAME PLACE.

HYDRAULIC AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 515,516, dated February 27, 1894.

Application filed February 20, 1893. Serial No. 463,007. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH H. CHAMP, a citizen of the United States, and a resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented certain new and useful Improvements in Hydraulic Air-Compressors, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

The annexed drawings and the following description set forth in detail, one mechanical form embodying the invention; such detail construction being but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings—Figure I represents a longitudinal vertical section of my improved air compressor; Fig. II, a longitudinal section,—on a smaller scale,—of another form of such air compressor; Fig. III, a longitudinal vertical section of still another form of the air compressor; Fig. IV, a longitudinal vertical section, taken on the line IV—IV in Fig. V, of the form of air compressor illustrated in Fig. I, and Fig. V, a transverse vertical section of said form of air compressor, taken on the line V—V in Figs. I and IV.

A main casing, A, which contains the valve mechanism, has a cylinder, B, secured to one side, said cylinder being secured to the casing at one end and projecting horizontally from the casing. As said cylinder B is the cylinder in which the air is compressed by the action of water, and water is always at one side of the piston in said cylinder while air is always at the other side of said piston, said cylinder is properly termed the air and water cylinder. A water cylinder, C, is secured to the diametrically opposite side of the main casing, and projects horizontally from the latter. Two pistons, D and E,—respectively an air and water piston and a water piston,—reciprocate in the two cylinders, and are connected by a piston rod, F, sliding in a suitable bearing, A′, in the main casing. The main casing is formed with a piston chamber, A^3; a valve chamber, A^2, above said piston chamber, of a smaller diameter than the latter, and communicating with the same; and a still smaller valve chamber, A^4, above the lower valve chamber A^2 and communicating with the same. A water inlet, G, enters the upper end of the piston chamber, and a water outlet, H, extends from the upper end of the lower valve chamber. A channel, *g*, extends from the water inlet to the upper end of the upper valve chamber. The lower valve chamber is surrounded by an annular channel, *a* which communicates with the interior of the valve chamber by an annular series of holes, *a′*, or similar annular ports. A channel, K, extends from the annular port channel to the outer end of the water cylinder C, and a channel, I′, extends from said annular port channel to the inner end of the air and water cylinder, so that the corresponding ends of said two cylinders are both connected to the same port of the valve chamber. The upper and smaller valve chamber A^4 is surrounded by an annular channel, a^2, which communicates with the interior of the valve chamber by an annular series of holes, a^3, or similar annular ports. A channel, J, extends from said annular port channel to the inner end of the water cylinder. A main controlling valve, L, slides in the piston chamber and valve chambers, and is provided with a large actuating piston, L′, within the piston chamber; a valve piston, L^2, of smaller diameter, in the larger valve chamber; and a still smaller valve piston, L^3, in the smaller valve chamber. A horizontal valve chamber, M, is formed in the main casing, and has two annular ports, *m* and *m′*, surrounding it and a port, m^2, near one end. One, *m*, of said ports communicates with the lower end of the piston chamber by means of a channel, m^3, and the other port, *m′*, communicates with the upper end of the piston chamber by means of a channel, m^4. The end port m^2, communicates with the upper end of the larger valve chamber A^2, by a channel, m^5, and through said chamber and channel, with the water outlet. In the same manner, the port *m′*, at the opposite side of the port *m*, communicates with the water inlet through the channel m^4 and the upper portion of the piston chamber.

A valve, N, which I shall term the primary valve, in contradistinction to the main controlling valve L,—said primary valve being

operated primarily to the main controlling valve, and controlling the actuating fluid for said latter valve, which again controls the actuating fluid for the pistons,—reciprocates in the primary valve chamber M, and has two pistons, n and n'; one, n, of which moves to both sides of the port m, while the other piston n', is permanently between the other port m' and the end of the valve chamber. The ends of the valve chamber are suitably closed by packings, n^2, and the ends of the valve stem project beyond the ends of the valve chamber so as to be engaged and shifted by the pistons in the air and water cylinder, and water cylinder when said pistons arrive at the inner ends of their respective strokes.

The air end or outer end of the air and water cylinder is provided with a valve casing, B′, having an air inlet provided with an air inlet valve, b', and an air outlet nozzle, b, leading from an air outlet valve, b^2.

In the form of air compressor illustrated in Fig. III, the channel K, which connects the larger valve chamber and the outer end of the water cylinder, is dispensed with, and said water connection is established through the piston rod, which is made hollow, and open through the outer side of the water piston and immediately inside of the air and water piston, so that water let into the inner or water portion of the air and water cylinder may pass through the hollow piston rod to the outer end of the water cylinder.

For the purpose of explaining the operation of the air compressor, the relative positions of the parts will be assumed to be such as illustrated in the drawings, and the water inlet will be assumed to be connected to a suitable source of water under pressure, such as a water service pipe, and the water outlet to open into a suitable waste. The actuating water passes from the inlet, through the valve chamber and the port and channels to the outer end of the water cylinder and to the inner end of the air and water cylinder. The air which has been drawn into the air portion of the air and water cylinder at the preceding stroke of the pistons, will be compressed by the air and water piston, which is forced outward by the joint pressure of the connected pistons,—the force of compression being equal to the sum of the water pressure upon the two pistons, less frictional resistance. When the pistons arrive at the extreme of their stroke, the water piston will bear against the projecting end of the primary valve stem, and will shift said valve so as to bring the port m which communicates with the lower end of the valve piston chamber, into communication with the port m^2 which communicates with the waste. This will allow the pressure of the inlet water,—acting from above upon the valve piston,—to force said piston down and to thus shift the main controlling valve so as to bring the inner end of the air and water cylinder and the outer end of the water cylinder in communication with the waste, while the inlet water will pass up through the vertical channel g, into the upper and smaller valve chamber A^4, and thence through the now uncovered port and channel J, into the inner end of the water cylinder. The water piston will thus be forced outward, expelling the water in both cylinders into the waste, and drawing air into the air portion of the air and water cylinder. When the pistons arrive at the end of this latter stroke, the air and water piston will shift the primary valve back to the position illustrated in the drawings, connecting the water inlet port m' of the primary valve chamber with the port m communicating with the lower end of the main controlling valve piston chamber, allowing the pressure of inlet water to raise the main controlling valve into the position illustrated and first described, when the operation just described will be repeated. When the air and water cylinder and the water cylinder have the same diameter, air may be compressed at twice the pressure of the actuating water, less frictional resistance, and in an air compressor, constructed like the one illustrated in Fig. II, where the area of the water piston is considerably greater than the area of the air and water piston, the pressure upon the air in the air portion of the air and water cylinder will be proportionately greater, although the volume of air compressed therein will, of course, be proportionately less.

Other modes of applying the principle of my invention may be employed for the mode herein explained. Change may therefore be made as regards the mechanism thus disclosed, provided the principles of construction set forth in the following claims are employed.

I therefore particularly point out and distinctly claim as my invention—

1. In an air compressor, the combination of an air and water cylinder, a water cylinder, pistons respectively in said cylinders and connected together, and valve mechanism controlling the simultaneous admission or exhaust of the actuating fluid to or from the air and water piston and the corresponding face of the water piston, and the corresponding exhaust or admission of the actuating fluid from or to the opposite face of the water piston, substantially as set forth.

2. In an air compressor, the combination of an air and water cylinder, a water cylinder, pistons respectively in said cylinders and connected together, and valve mechanism controlling the actuating fluid at one side of the air and water piston and at both sides of the water piston, substantially as set forth.

3. In an air compressor, the combination of an air and water cylinder, a water cylinder, pistons respectively in said cylinders and connected together, and valve mechanism actuated by said pistons and controlling the actu-

ating fluid at one side of the air and water piston, and at both sides of the water piston, substantially as set forth.

4. In an air compressor, the combination of an air and water cylinder, a water cylinder, pistons respectively in said cylinders and connected together, a main controlling valve operated by the actuating fluid and controlling said fluid at one side of the air and water piston and at both sides of the water piston, and a primary valve in the path of the pistons and controlling the actuating fluid for the main valve, substantially as set forth.

In testimony that I claim the foregoing to be my invention I have hereunto set my hand this 13th day of February, A. D. 1893.

JOSEPH H. CHAMP.

Witnesses:
WM. SECHER,
J. C. TURNER.